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Standard Specification for Vertiport Design[1]

This standard is issued under the fixed designation F3423/F3423M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification defines the requirements for the planning, design, and establishment of vertiports intended to service vertical takeoff and landing (VTOL) aircraft. These aircraft include, but are not limited to, standard category aircraft, optionally piloted aircraft, and unmanned aircraft. Aircraft not covered by this specification include VTOL aircraft less than 55 lb [25 kg]. In developing these standards, identified types of eVTOL aircraft, for example, Multi-Rotor, Lift & Cruise, Vectored Thrust, Tilt Wing, Tilt Rotor, etc., were considered. Ultimately it is up to the authorities having jurisdiction (AHJ) as to how and to what extent these standards are applied. Vertiports may provide commercial or private services in support of the operation of eVTOL aircraft including, but not limited to, some or all of occupant and cargo transport, air medical, flight instruction, aerial work, aircraft rental, fueling, charging of energy storage devices, battery exchange, hangaring, and maintenance services.

1.2 This specification is intended to support the design of civil vertiports and vertistops, however, it may also be used as a best practice document for other facilities.

1.2.1 *Vertiport* is a generic reference to the area of land, water, or structure used, or intended to be used, for the landing and takeoff of VTOL aircraft, together with associated buildings and facilities. At this time, aircraft with floats conducting water landings and takeoffs are not included in this specification.

1.2.2 *Vertistop*—The same as *Vertiport*, except that no fueling, defueling, scheduled maintenance, scheduled repairs, or storage of aircraft is permitted. Unscheduled maintenance and repairs to return an aircraft in an AOG (Aircraft on Ground) status to a serviceable status are permissible.

1.3 This document may present information in either SI units, English Engineering units, or both. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F3060 Terminology for Aircraft

F3341/F3341M Terminology for Unmanned Aircraft Systems

2.2 *AIA Standards:*[3]

NAS National Aerospace Standards

2.3 *FAA Standards:*[4]

14 CFR Part 77 Safe, Efficient Use and Preservation of the Navigable Airspace

14 CFR Part 157 Notice of Construction, Alteration, Activation, and Deactivation of Airports

AIM Aeronautical Information Manual

FAA Pilot/Controller Glossary

FSIMS 8900.1 Vol 8, Ch 3, Sec 3 Evaluation and Surveillance of Heliports

AC 00-34A Aircraft Ground Handling and Servicing

AC 70/7460 Obstruction Marking and Lighting

AC 150/5200-33B Hazardous Wildlife Attractants on or Near Airports

AC 150/5345-27E Specification for Wind Cone Assemblies

AC 150/5390 Heliport Design Guide

Order JO 6700.20B Non-Federal Navigational Aids, Air

[1] This specification is under the jurisdiction of ASTM Committee F38 on Unmanned Aircraft Systems and is the direct responsibility of Subcommittee F38.02 on Flight Operations.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Aerospace Industries Association (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209, http://www.aia-aerospace.org.

[4] Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, http://www.faa.gov.

Traffic Control Facilities, and Automated Weather Systems Document Information
Order JO 7110.65X Air Traffic Organization
Order JO 7400.2 Procedures for Handling Airspace Matters
Airports Engineering Brief #87 Heliport Perimeter Lights for Visual Meteorological Conditions (VMC)

2.4 *ICAO Standards:*[5]
ICAO Heliport Manual/Doc 9261
ICAO Annex 14, Aerodromes Volume II Heliports

2.5 *ICC, International Code Council*[6] Standards:[7]
IBC[6] International Building Code[6]
IFC[6] International Fire Code[6]

2.6 *IES Standard:*[8]
RP-37-15 Outdoor Lighting for Airport Environments

2.7 *NFPA*[9] Standards:[10]
NFPA 70[9] National Electrical Code[9]
NFPA 101[9] Life Safety Code[9]
NFPA 407 Standard for Aircraft Fuel Servicing
NFPA 409 Standard on Aircraft Hangars
NFPA 418 Standard for Heliports
NFPA 855 Standard for the Installation of Stationary Energy Storage Systems

2.8 *OSHA/ANSI Standards:*[11]
Title 29 CFR Part 1910.23 Ladders
Title 29 CFR Part 1926.502 Fall Protection Systems Criteria and Practices

3. Terminology

3.1 *Unique and Common Terminology*—Terminology used in multiple standards is defined in F3341/F3341M, UAS Terminology Standard, and F3060, Aircraft Terminology Standard. Terminology that is unique to this specification is defined in this section.

3.2 *Definitions:*

3.2.1 *Air Gap, n*—An unobstructed clear area dimensionally dependent on site-specific conditions that is located under a rooftop vertiport and between it and the architectural structure immediately below it, which is designed to allow the air circulating around and over a building to flow under the vertiport rather than over the vertiport to reduce turbulence at the landing and takeoff site(s).

3.2.2 *Air Taxi, n*—Used to describe a VTOL aircraft movement conducted above the surface but typically below 100 ft [30.5 m] AGL, which allows for more rapid aircraft movement from one point to another.

3.2.3 *Approach Surface (VFR), n*—The approach surface begins at each edge of the vertiport FATO with the same width as the FATO and extends outward and upward for a horizontal distance of 4000 ft [1219.2 m] where its width is then 500 ft [152.4 m]. The slope of the approach surface is 8:1. Although VTOL approach/departure paths may curve, the length of the approach/departure surface remains fixed. The approach surface slope may be reevaluated on a case-by-case basis at such time performance data for individual aircraft has been certified and published that would indicate a steeper, higher performance profile may be safely accomplished and accommodated for.

3.2.4 *Controlling Dimension (CD), n*—The greatest distance between the two outermost opposite points on an aircraft as measured along either the horizontal or longitudinal axis (that is, wingtip to wingtip, rotor tip to rotor tip, rotor tip to wingtip, fuselage to rotor tip, fuselage to fuselage, etc.), measured on a level horizontal plane that includes all adjustable components extended to their maximum outboard deflection. This equates to the smallest circle enclosing the VTOL aircraft projection on a horizontal plane in all possible operational configurations with rotor(s) turning.

3.2.5 *Design Aircraft, n*—A single or composite, that is, multiple, aircraft that reflects the maximum weight, maximum contact load/minimum contact area, controlling dimension, undercarriage dimensions, and pilot's eye height of all aircraft expected to operate at the vertiport.

3.2.6 *Dynamic Load, n*—For design purposes, assume the dynamic load at 150 percent of the maximum takeoff weight of the design aircraft applied through the main undercarriage on a wheel-equipped aircraft or aft contact areas of skid-equipped aircraft.

3.2.7 *Elevated Vertiport, n*—A vertiport located on a raised structure on land. (A ground-level vertiport where the TLOF is located on an earthen mound is not considered an elevated vertiport).

3.2.8 *Electric Vehicle Power Transfer System, n*—A means of replenishing an aircraft's electrical energy reserves. This includes portable and stationary charging systems that are designed to be connected to an aircraft as well as battery swapping programs. **NFPA 70**

3.2.9 *Energy Storage System (ESS), n*—Complete energy storage device consisting of one or more energy storage cells arranged into one or more packs, with ancillary subsystems for physical support and enclosure, thermal management, and electronic control. Typical energy storage cells include, but are not limited to, batteries or capacitors.

3.2.10 *FATO, n*—Final Approach and Takeoff area; a defined area over which the aircraft completes the final phase of the approach to a hover or a landing, and from which the aircraft initiates takeoff that has an unobstructed perimeter area that allows for safe maneuvering of the design aircraft in all modes of operation. The FATO elevation is the lowest elevation of the edge of the TLOF. The FATO may or may not need to be load bearing dependent upon the type of operations that are intended to be conducted.

[5] Available from International Civil Aviation Organization (ICAO), 999 Robert-Bourassa Blvd., Montréal, Québec H3C 5H7, Canada, https://www.icao.int.
[6] A registered trademark of the International Code Council, Inc.
[7] Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, http://www.iccsafe.org.
[8] Available from Illuminating Engineering Society (IES), 120 Wall Street, 17th Floor, New York, NY 10005-4001, https://www.ies.org.
[9] A registered trademark of National Fire Protection Association.
[10] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.
[11] Available from Occupational Safety and Health Administration (OSHA), 200 Constitution Ave., NW, Washington, DC 20210, http://www.osha.gov.

3.2.11 *Ground Taxi, n*—The surface movement of a wheeled VTOL under its own power with wheels touching the ground.

3.2.12 *Ground Towing, n*—The movement of an aircraft while in contact with the ground with the assistance of a ground handling device where the aircraft is not producing thrust or lift.

3.2.12.1 *Discussion*—See FAA AC 00-34A, Aircraft Ground Handling and Servicing.

3.2.13 *Hover Taxi, n*—Used to describe the movement of a wheeled or skid-equipped VTOL aircraft above the surface, typically used to move short distances from one point to another. Generally, this task takes place at a wheel/skid height of 1 ft to 5 ft [0.3 m to 1.5 m] and at a ground speed of less than 20 knots [37 km⁄h]. For facility design purposes, assume a skid-equipped eVTOL aircraft to hover-taxi.

3.2.14 *Imaginary Surfaces, n*—Surfaces used for the purposes of preventing existing or proposed man-made objects, objects of natural growth, or terrain from extending upward into navigable airspace. These surfaces include the Approach Surface, Primary Surface, and Transitional Surface.

3.2.15 *Parking Position, n*—A designated location at a Vertiport designed for transient aircraft to be positioned by means of ground or air taxi taxiways for the purpose of loading and unloading of cargo or passengers, charging, fueling, or short duration maintenance. Landing and takeoff operations are not permitted from designated parking positions. A TLOF may be used as a parking position with the understanding that it may reduce or halt landing and takeoff operations until the aircraft has cleared the location.

3.2.16 *Predesignated Emergency Landing Area (PELA), n*—A location identified as a potential emergency landing site for an aircraft in distress to land when continued flight is unadvised due to an off-nominal situation concerning maintenance, weather, or an inflight emergency.

3.2.17 *Primary Surface, n*—An imaginary surface positioned along a horizontal plane at the established elevation of a vertiport that coincides in size and shape with the designated takeoff and landing area FATO.

3.2.18 *Rotor Load, n*—Rotor downwash loads are approximately equal to the weight of the aircraft distributed uniformly over the disk area of the rotors.

3.2.19 *Safety Area, n*—A defined unobstructed area surrounding the FATO of a vertiport designed to allow for any accidental divergence of an aircraft from the FATO perimeter.

3.2.20 *Safety Net, n*—A physical and structurally supported safety device surrounding any landing/takeoff surface, parking areas, taxiway, walkway, access point, passenger area, and crew area that is elevated greater than 30 in. that is designed to provide fall protection in accordance with OSHA standard Title 29 CFR Part 1910.23 Ladders and Title 29 CFR Part 1926.502 Fall Protection Systems Criteria and Practices.

3.2.21 *Static Load, n*—For design purposes, the design static load is equal to the aircraft's maximum takeoff weight applied through the total contact area of the wheels or skids.

3.2.22 *Taxiway (TW), n*—Defined unobstructed clear path established for the taxiing (air, ground, or both) of aircraft from one part of a vertiport to another.

3.2.23 *TLOF, n*—Touchdown and Liftoff Area; a load-bearing surface area normally centered in its own FATO, on which the aircraft may touchdown or liftoff.

3.2.24 *Transitional Surfaces, n*—These surfaces extend outward and upward from the lateral boundaries of the primary surface and from the approach surfaces at a slope of 2:1 for a distance of 250 ft [76.3 m] measured horizontally from the centerline of the primary and approach surfaces.

3.2.25 *Vertical Lift Aircraft, n*—Heavier-than-air aircraft capable of vertical takeoff and vertical landing.

3.2.26 *Vertiport Elevation, n*—The highest point of a vertiport's FATO measured in feet or meters above mean sea level or equivalent elevation component as approved by the authority having jurisdiction.

3.3 *Performance Classifications:*

3.3.1 *Ground Effect, n*—When hovering near the ground, a phenomenon known as ground effect takes place. This effect usually occurs at a consistent distance above the surface that is proportional to the main rotor diameter for helicopters, or total disk area for multirotor vehicles. As the induced airflow through the rotor disc is reduced by the surface friction, the lift vector increases. This allows a lower rotor blade angle, or reduced RPM, for the same amount of lift, which reduces induced drag.

3.3.2 *Hover In Ground Effect (HIGE), v*—Hovering in close proximity to the surface to where the aircraft is under the influence of ground effect.

3.3.3 *Hover Out of Ground Effect (HOGE), v*—Hovering at a height above the surface to where the aircraft is not influenced or assisted by ground effect. Because induced drag is greater while hovering out of ground effect, it takes more power to achieve a hover.

3.3.3.1 *Discussion*—Aircraft that land or takeoff from a rooftop or elevated vertiport will generally need to meet HOGE power requirements to ensure safe operations can be maintained as indicated by the aircraft manufacturer's performance standards for the environmental conditions present. Additional performance considerations to consider include situations of high-density altitude, high aircraft gross weights, site location, wind direction, wind speed, high environmental temperatures, and increased elevations.

3.4 *Abbreviations:*

3.4.1 *AGL*—above ground level

3.4.2 *CAA*—civil aviation authority

3.4.3 *eVTOL*—electric vertical takeoff and landing

3.4.4 *IFR*—instrument flight rules

3.4.5 *NFPA*[9]—National Fire Protection Association

3.4.6 *VFR*—visual flight rules

3.5 See FAA Aeronautical Information Manual (AIM) and FAA Pilot/Controller Glossary for additional clarification of aviation terminology.